

Quarterly Status, Management, and Cost Report

Contract Name: Seismic Calibration for IMS Stations in North Africa and Western Asia (Group 2)

Contractor: Science Applications International Corporation

Contract Number: DTRA01-00-C-0013

Contracting Officer: Ms. Shirley Bauer
DTRA/AMO, 45045 Aviation Drive, Dulles, VA 20166-7517,
703-810-4637, 703-810-4675(FAX), shirley.bauer@dtra.mil

Contracting Officer Technical Representative: Dr. Anton Dainty
DTRA/OSTN, 45045 Aviation Drive, Dulles, VA 20166-7517,
703-810-4198, 703-810-4159(FAX), anton.dainty@dtra.mil

Project Manager: Dr. Keith L McLaughlin
CMR/SAIC, Suite 1450, 1300 N 17th St. Arlington, VA 22209,
703-247-4135, 703-524-2073(FAX), scatter@cmr.gov

Contracts Manager: Ms. Susan Haverland
SAIC, 4770 Eastgate Mall Rd. San Diego, CA 92121, 858-826-
5548, 858-826-4993 (FAX), susan.c.haverland@saic.com

Period of Performance: March 1, 2000 – February 28, 2003

Reporting Period: June 1, 2000 – September 9, 2000

Background

The Group 2 Consortium is composed of SAIC as the prime contractor with Harvard University, Colorado University Boulder (CUB), University of California San Diego (UCSD), Geophysical Institute of Israel (GII), Multimax, and Western Services as subcontractors. SAIC personnel are resident at the Center for Monitoring Research (CMR).

Travel-time corrections will be developed, tested, and validated in two phases over a period of three years. The team will construct location corrections, as recommended by CTBT/WGB/TL-2/18, using three methodologies: 1) Tectonic regionalization will be used to assign 1D velocity models to each tectonic province and SSSCs computed by 2D and 3D ray-tracing. 2) 3D hybrid models consisting of global and regional models will be constructed and ray-tracing will be performed. 3D hybrid models will make use of the best available models for each region and include tectonic regionalization in areas with poor model coverage. Team members as part of related work may perform revision of 3D models using available data in selected regions. 3) Event clusters will be selected and

Joint Hypocenter Determination (JHD) will be used to define empirical travel time corrections for small selected regions. Inter-comparison of methodologies will contribute to a priori modeling error estimates. Offline unit testing and validation of model-based SSSCs will be performed using existing and expanded Ground Truth (GT).

Progress in Current Reporting Period

(June 1, 2000 - August 31, 2000)

SAIC was placed under contract on March 1st, 2000. All subcontracts were signed during this reporting period.

Members of the Group 2 Consortium, Keith McLaughlin (CMR), Robert North (CMR), Xiaoping Yang (CMR), István Bondár (CMR), Hans Israelsson (CMR), Victor Kirichenko (Western Services), Adam Dziewonski (Harvard Univ.), Goran Ekström (Harvard Univ.), Michael Antolik (Harvard Univ.), Robert Engdahl (Colorado Univ.), Michael Ritzwoller (Colorado Univ.), Avi Shapira (GII), Winston Chan (Multimax), Indra Gupta (Multimax), Wilmer Rivers (Multimax) and Robert Wagner (Multimax) attended the first general Consortium meeting at CMR on June 5-6. A detailed schedule and action items have been posted on the Consortium's web site (<http://g2calibration.cmr.gov>).

In response to the memo on "DoE Data Sets for IMS Location Calibration" to David Harris (LLNL), Aaron Velasco (LANL), Leslie Casey (DoE). Anton Dainty (DTRA) from: Keith L. McLaughlin (scatter@cmr.gov) Group 2 Consortium PI on Tuesday, April 18, 2000, Leslie Casey (DOE) sent a letter to Anton Dainty (DTRA) on July 12, 2000 with copies to Keith McLaughlin (Group 2 Consortium PI, CMR), Group 2 Consortium subcontractor PIs and Stanley Ruppert (LLNL product integrator). An LLNL report, "LLNL Basic and Applied Research Datasets for Seismic Calibration of IMS Stations in North Africa and Western Asia, Version 1.0", UCRL-ID-139534, was attached to the DOE letter. A subset of DOE data was requested by the Consortium, and personal communication with Stanley Ruppert (LLNL) and Jennifer O'Boyle (LLNL) confirmed that the DOE data transfer is in progress.

The Group 2 Consortium web site at CMR, <http://g2calibration.cmr.gov>, has been further developed by adding new features such as [References](#), [Links](#) and [Acknowledgements](#). The site is updated on a daily basis.

The database schema for collecting location calibration metadata has been finalized.

Collection of relevant papers from the literature has been initiated at the CMR.

A database of contacts in the region has been created at the CMR.

Reference events (GT0-5) are being collected in the Consortium's region of interest (15S-80N, 40W-100E):

- 1135 reference events are being considered from the CMR Ground Truth and Nuclear Explosion database, of which 841 have arrival time data from IMS or GSETT-3 stations.
- Multimax made a thorough study of the IGN, Madrid, Spain bulletins for the period January 1998 and May 2000 and selected 12 reference events.

- CUB submitted 117 potential reference events selected from NGRI, Hyderabad, India and DOE bulletins and ISC/NEIC groomed data sets.
- GII provided 39 potential reference events from Greece, Italy and Turkey using data from local and regional bulletins.
- Bulletins for reference events in the former Soviet Union collected at Harvard are being released.
- CUB created a new groomed version of the ISC/NEIC bulletins for the period 1964 – 1999. The groomed data set consist of nearly a million hypocenters and associated phase arrival times, as well as new phase data obtained from other sources, which have been reprocessed using the EHB algorithm (Engdahl, et al., 1998).

Event clusters are being collected and analyzed in the region of interest:

- CMR selected 46 event clusters (number of events > 5) with associated ground truth (GT0-5) information.
- CUB performed high-resolution cluster analysis on the 1997 Jiashi swarm in western China and a 1997 earthquake sequence in eastern Iran.
- GII submitted an aftershock sequence in Umbria-Marche, Italy, 1997.

Model development is under way:

- CUB created an inventory of surface wave (Rayleigh and Love group and phase velocity) measurements and P and S models available for the Consortium.
- CUB made ray-tracing programs based on shooting and finite difference methods (Villasenor et al., 2000a) available for the Consortium.
- Harvard made available surface wave phase velocity (Rayleigh and Love) measurements (Ekström et al., 1997) and long period travel time residuals for major teleseismic phases measured by cross-correlation of observed waveforms with synthetic seismograms calculated for the Earth model PREM (Dziewonski et al., 1996, Liu and Dziewonski, 1998).
- Both CUB and Harvard created a secure website for the consortium.
- CMR developed a preliminary regionalization of the region of interest.
- CUB constructed preliminary hybrid models by combining global mantle models with global crust and upper mantle models (Villasenor et al., 2000b).

Two papers (Group 2 Consortium, and Ritzwoller et al., 2000) were submitted for the Seismic Research Symposium to be held in New Orleans, September 13-15, 2000.

References

- Dziewonski, A.M., G. Ekström and X.-F. Liu, Structure at the top and bottom of the mantle: two examples of use of broad-band data in seismic tomography, in *Monitoring a Comprehensive Test Ban Treaty*, eds. E.S. Husebye and A.M. Dainty, 521-550, Kluwer Academic Publishers, 1996.
- Ekström, G., J. Tromp and E.W.F. Larson, Measurements and global models of surface wave propagation, *JGR*, 102, 8137-8157, 1997.
- Engdahl, E.R., R. van der Hilst and R. Buland, Global Teleseismic earthquake relocation with improved travel time and procedures for depth determination, *BSSA*, 88, 722-743, 1998.

- Group 2 Consortium, Source Specific Station Corrections (SSSCs) for International Monitoring System (IMS) Seismic Stations in North Africa, Middle East and Western Asia, 22nd CTBT SRS, 2000.
- Liu X.-F. and A.M. Dziewonski, Global analysis of shear wave velocity anomalies in the lowermost mantle, in AGU Monograph: Core-Mantle Boundary, M Gurnis et al. eds., American Geophysical Union, Washington DC, 21-36, 1998.
- Ritzwoller, M.H., M.P. Barmin, A.L. Levshin, A. Villasenor, and E.R. Engdahl, Estimates of Pn and Sn across Central Asia, 22nd CTBT SRS, 2000.
- Villasenor, A., M.H. Ritzwoller, M.P. Barmin, E.R. Engdahl and A.L. Levshin, Computation of travel times and station correction surfaces in Eurasia using 3D velocity models, 22nd CTBT SRS, 2000a.
- Villasenor, A., M.H. Ritzwoller, A.L. Levshin, M.P. Barmin, E.R. Engdahl, W. Spakman and J. Trampert, Shear velocity structure of Central Asia from inversion of surface wave velocities, PEPI, in press, 2000b.

Plans for Next Reporting Period (September 1, 2000 – December 31, 2000)

The second general Group 2 consortium meeting will be held during the SRS meeting in New Orleans on September 15, 2000. Detailed agenda of the meeting and the action items agreed during the meeting will be posted on the consortium web site.

Two poster presentations will be made at the September 13-15, 2000 SRS meeting in New Orleans.

DOE data sets from LLNL for IMS location calibration will be installed in the Consortium database at the CMR.

Collection of reference events, event clusters and local and regional velocity models will be continued.

Regionalization of the area will be refined.

Preliminary SSSCs will be calculated through both regionalized and hybrid 3D models.

A secure website for data exchange within the Consortium will be created at the CMR.

A depository of Consortium data on a dedicated (36 Gbyte) disk will be created at the CMR.

Cost Report

See attachments.